Travel Behavior in Two Sub-Saharan African Cities: Maputo and Nairobi. Focusing on Rapid Motorization, Public Transportation, and Poverty issues

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Commuters in Sub-Saharan African cities face increased challenges in their daily mobility, yet studies on their travel behavior are minimal. Most people resort to walking long distances to access their destinations because they cannot afford any form of motorized trips. Using person-trip survey data, this paper tries to investigate the commuting travel behavior in two Sub-Saharan African cities such as Maputo and Nairobi by focusing on motorization, public transportation, and poverty issues. This research is expected to have a significant impact on the direction of transportation policy aiming to increase the use of public transportation in developing cities while addressing the negative effects associated with the rapid motorization.

Keywords: Person Trip Data, Chapas, Matatus, Regression Analysis

1. INTRODUCTION

Before discussing the commuting travel behavior in the selected Sub-Saharan African cities one needs to define poverty and motorization. There are two main approaches used to define poverty: conventional economic definition and absolute definition. The former defines people as poor when their income or consumption is less than that required to meet certain defined needs. Under the absolute definition, poverty is defined in absolute terms, and needs are considered to be fixed at a level which provides for subsistence, basic household assets, and expenditure on essential services such as transportation (World Bank, 1990; Wratten, 1995).

However, in Sub-Saharan African cities where informality is basically the rule and official statistics are unable to capture earnings from the non-formal sector, using conventional economic definition alone might be misleading. In this paper, we consider both definitions where monthly income is reported and use only household asset ownership where data is not available. Likewise, motorization can have several meanings. However, in this study, we define motorization as the rise in car use (Kutzbach, 2009).

It is widely accepted that with the rapid urbanization, more people will live in urban areas in developing countries. As a result, the number of people in poverty is also expected to increase at a faster rate (World Bank, 2002; Wratten, 1995). Sub-Saharan

Africa, in particular, contains a growing share of the world's absolute poor: one in three poor people live in Sub-Saharan Africa (Cohen, 2006). At least a minimum understanding of travel behavior is required to address the mobility needs in Sub-Saharan African cities. According to (Howe et al. 2010) relatively little is known about the travel behavior of the poor in developing countries as well as their residential location. Similarly, (Verma and Manoj, 2015; Cheng et al. 2013) add that studies on the travel behavior of low-income in the developing world are rare. It is this limited background in the Sub-Saharan African context that motivated the present research.

The main purpose of this paper is to contribute to the understanding of the travel behavior in Sub-Saharan African cites such as Maputo and Nairobi by focusing on the rapid motorization, public transportation, and poverty issues. This research is expected to have a significant impact on the direction of transportation policies aiming to increase the use of public transportation while addressing the negative effects associated with the rapid motorization. As case studies, Maputo and Nairobi are selected because they are among the few Sub-Saharan African cities that managed to maintain their public bus companies. Second, the two cities face the rapid rise in car use, whereas poor individuals cannot afford any form of motorized trips (Salon and Aligula, 2012; Tembe et al.,2017).

(1) Objectives

- To identify the similarities and variations on the travel behavior between Maputo City and Nairobi City;
- To investigate the impact of motorization and poverty on the travel behavior.

(2) Structure

The paper is organized as follows. In section 2, previous studies are reviewed. Section 3 discusses briefly the dataset and methodology used in this study. Section 4 introduces the fundamental features of the selected cities, followed by travel behavior analysis in section 5. Section 6 is devoted to expected model results.

2. LITERATURE REVIEW

The literature on the travel behavior in the context of Sub-Saharan Africa is still minimal. A research on the travel behavior in Nairobi by Salon and Aligula (2012) indicates that slum dwellers cannot afford any transport mode and they cope by reducing their travel to walking. Salon and Aligula (2012) also compared the travel patterns between poor and non-poor households and found the former to be systematically worse off. Likewise, Howe and Bryceson (2010) also investigated the mobility of low-income in two Sub-Saharan African cities, Harare in Zimbabwe, and Kampala, in Uganda. Their results show the livelihood of work to be the most frequent purpose of short-distance trips for all income groups. In addition, walking dominated the modal share in both cities with households in Kampala also relying on bicycle and motorcycle taxi.

Sohail et al. (2004) investigated public transportation in Dar es Salaam, Tanzania, and concluded that poor people are affected not only by the current fares that are too high but lack of services in poor roads. Most poor people are reported to rely heavily on public transportation. Their main trip purposes include petty trading, work, school, farming, and social activities. A study on mobility in 6 Sub-Saharan African cities by (Olvera et al.,2013) revealed a relatively small public transport sector concentrated on the major radial roads on one hand, and an increasing informal sector or paratransit. Household ownership of motorized two-wheelers and the private car is reported to be very low. A comparison of urban transport systems across African cites by (Godard, 2013) identified affordability as the main concern for the use of buses and paratransit. For example, a substantial share of urban dwellers was found to have no daily access to public transport services because these are expensive and not easily accessible.

ITO et al. (2013) examined the general mechanism of motorization in Asian developing mega-cities. ITO et al. (2013) found motorization to be influenced mainly by the economic growth and urban structure change. They described the motorization mechanism as follows. Initially, car ownership rises due to economic growth. Then, car ownership growth enhances the convenience of movement and accelerates the expansion of the urban area to suburbs. Dargay et al. (1999) used historical data for more than three decades worldwide and found a strong relationship between the growth of per-capita income and the growth of car ownership levels. Car and vehicle ownership are expected to continue growing as income per-capita increases. Fujiwara et al. (2007) investigated the motorization in terms of passenger cars and motorcycles in the Asian context. Their findings indicate that motorization is increasing rapidly in the Asian context.

3. DATA AND METHODOLOGY

(1) Basic statistics

Household Interview Survey (HIS) or Person-trip data that are used in this paper were conducted in 2012 and 2013 in Maputo and Nairobi, respectively, by Japan International Cooperation Agency (JICA). Person trip data consist of a wide range of information including (1) household characteristics, (2) individual characteristics, and (3) the transportation behavior in the previous 24hour period

(2) Logistic regression

Two separate regression models will be estimated to achieve the goal of this research. According to (Gujarati, 2011) regression models that involve nominal scale variables can be either binary or dummy variable, dependent models. (Chacha and Bwire, 2013) argue that logit models are by far the most widely applied discrete choice models due to the fact that the formula for the choice probabilities takes a closed form and is readily interpretable. This research employs the logistic regression models.

4. FUNDAMENTAL FEATURES OF THE CITIES

We review the background upon which the urban transportation systems were built on to understand the travel behavior of the urban poor in each city. This can help us to understand the current conditions considering that none of these cities ever experienced significant changes in the supply side since their independence. First, we analyze how urban transportation systems evolved in Maputo followed by Nairobi.

(1) Maputo

Mozambique is an independent country since 1975. Urban transportation systems were nationalized at the outset yielding to a regulated public transport system. Urban transportation services were exclusively provided by a state-owned Bus company, *Transportes Publicos de Maputo* (TPM). Fares were regulated with a purpose to ensure affordability of the majority of the population. At the beginning of the 1980s, Maputo witnessed an increased immigration of people from rural to the capital city, while the Bus Company had difficulties to provide bus services to economic policies. For example, the bus utilization ratio which is the proportion of buses in service over the total bus fleet, reduced from approximately 37% in 1975 to roughly 13% as of 1985. For this study nominal buses are defined as the bus fleet owned by the company, while operating buses represent the number of buses in service.

As a result of the problems above, the number of passengers gradually declined from 60 million users in 1975 to 40 million in 1985. Kumar and Barret (2008) argue that in the beginning public bus companies were able to operate without subsidies in Africa, however, as deficits grew and subsidies did not grow commensurately, bus operators faced

(2) Nairobi

Urban transport services in Nairobi were exclusively provided by Kenyan Bus Services (KBS) until 1973 (UITP, 2008). According to (UITP, 2008), Kenya Bus Services (KBS) was established in 1934 and it operated urban transport services utilizing high capacity buses (double-decker). Bus fares were controlled at the level that allowed the company to operate profitably and to expand (Kumar & Barret, 2008). Kenya Bus Services also encountered difficulties due to regulatory institutions which resulted in the declining market share. Kenyan authorities legalized the paratransit operators *matatus* in 1973 to meet the increasing needs for transportation (Kumar and Barret, 2008). However, *matatus* are reported to have started their transport services in the 1950s and they were considered as illegal commercial operators (UITP, 2008). Similarly, the seating-capacity of matatus ranges from 14 to 25 passengers. According to (Kumar and Barret, 2008), *matatus* were mainly used as a transportation mode of native Africans during the colonial period. The word *matatu* means 30 cents which were the standard flat fare that was charged.

(Kumar and Barret, 2008) state that even with the legalization of *matatus* Kenyan Bus Company retained the monopoly status which was only broken at the outset of the 1980s with the formation of another state bus company *Nyayo Bus services*. (Dimitriou & Gakenheimer, 2011) As of 2013, the modal share is primarily by walk (39.7%), followed by *matatus* (28.4%), private car (13.5%), bus (12.2%), rail (0.2%) and others (5.9%).

5. TRAVEL BEHAVIOR ANALYSIS

Fig.1 shows the basic characteristics of the households in the selected cities. As it can be seen Maputo and Nairobi exhibit similarities and variations. The number of households with less than 3 members is minimal in Maputo but greater in Nairobi. There are at least two explanations for this result. Firstly, person trip survey only covered Nairobi City while in the case of Maputo the whole metropolitan area was surveyed. There is a tendency for

households in the city area to owning more private cars compared to the rest of the metropolitan area. (Salon and Aligula, 2012) argue that most Kenyans move out of the city when they retire.

Fig.2 summarizes household car ownership. Both cities are characterized by a greater number of households with no private car. The number of households with one vehicle is relatively greater in Nairobi City compared to Maputo. We analysed census data in **Figs.3-4** to deriver proper insights about the socioeconomic similarities and variations between the two cities. The number of households owning non-expensive assets such as radio, TV set is higher in Maputo than Nairobi. On the other hand, ownership of the computer, bicycle, motorcycle, and private cars is minimal in both cities. These results are not surprising because the two cities still rank among cities with a higher level of poverty (Salon and Aligula, 2012; World Bank, 2016).

Figs.5-6 present the number of trips classified by age structure. The proportion of total trips dominated by individuals under 19 years of age is greater in Maputo than Nairobi. This result should be given the difference in the age structure of households. In contrast, the share of total trips by commuters aged 20 to 49 years old is higher in Nairobi compared to Maputo. This might result from differences in the working population between the two cities. The proportion of the unemployed is greater in Maputo compared to Nairobi. Bryceson et al. (2010) state that the employment in East Africa is dominated by the informal sector. As a result of the increasing importance of the informal sector activities as a source of income, travel behavior is also changing. In the case of Maputo, one of the main implications of age structure is that temporal trip distribution is characterized by three peak-hour periods in large part due to school activities (Tembe et al., 2017).

Figs.7-8 represent transportation choice by gender. Surprisingly, mode choice by gender is similar between and within the two cities. The most remarkable result is the proportion of female relying on walking as their transport mode is greater than the male in both cities. This is likely to be related to poverty issues that affect disproportionately the female-headed households in Sub-Saharan Africa region. The share of public transportation (*matatus*, *chapas*, and buses) is similar between the two cities, whereas the ratio of the private car is greater for male than female. Unlike, East Asian developing cities the share of motorcycle use by poor households is lower in the two cities. This is probably because of the higher costs associated with imports from the major motorcycle manufactures such as China.
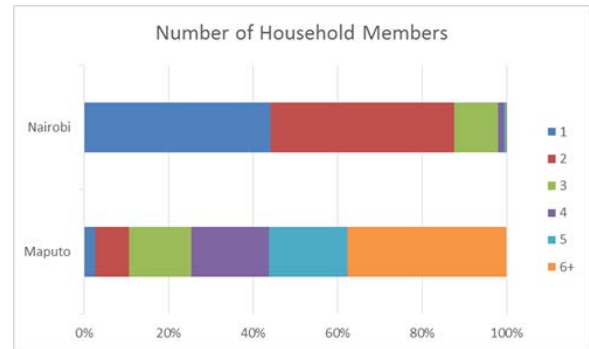

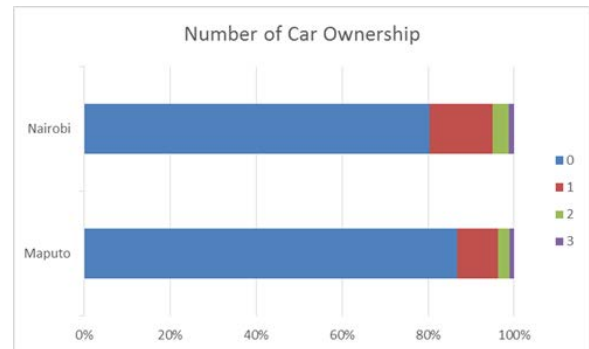Figure 1. Household composition. Source: HIS

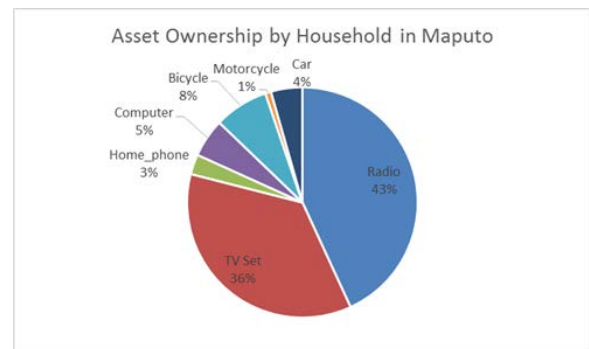Figure 2. Car ownership. Source: HIS

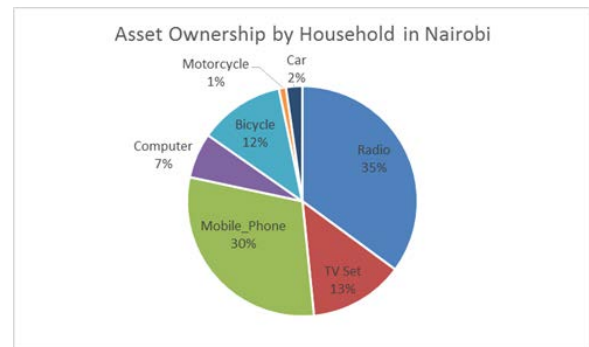Figure 3. Household asset ownership. Source: Census

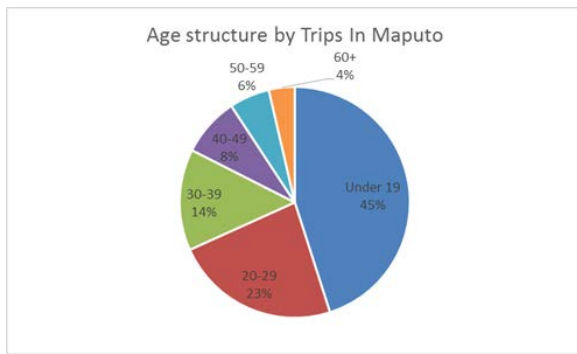Figure 4. Household asset ownership. Source: Census

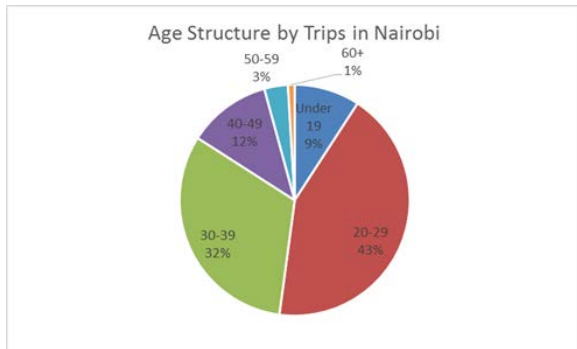Figure 5. Trips by age structure. Source: HIS
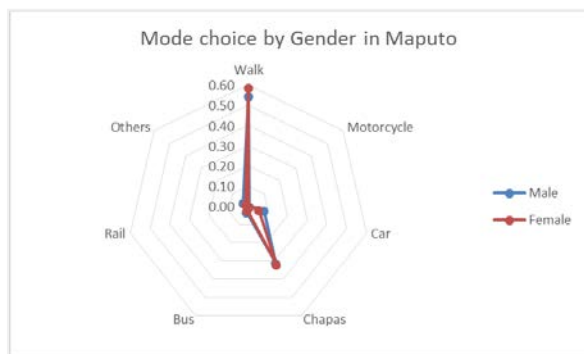

Figure 6. Trips by age structure. Source: HIS

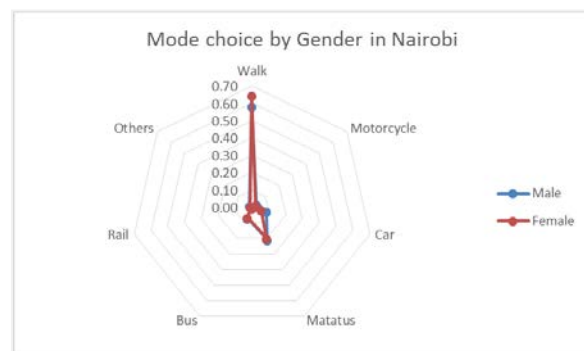Figure 7. Mode choice by gender. Source: HIS

Figure 8. Mode choice by gender. Source: HIS

6. EXPECTED RESULTS

The results of this research are expected to have a significant impact on the direction of transportation policy aiming to increase the use of public transportation in developing cities while addressing the negative effects associated with the rapid motorization

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